Population Projection

Methodology and Assumptions

Introduction

Population projections for Alberta and each of its 19 census divisions are available for the period 2017 to 2041 by sex and single year of age. Three growth scenarios have been prepared. The medium scenario represents the most likely case, and is the reference scenario over the projection period. The high scenario captures the possibility of higher growth in certain components (births, deaths and migration) and consequently higher population growth, whereas lower growth is projected under the low scenario (Figure 1).

These projections represent a plausible progression of the population based on the current population base and assumptions regarding future demographic developments. The first decade of the projections incorporates a forecast component consistent with that used in developing the economic outlook for the Alberta Budget. The latter part of the projection follows a standard demographic approach in which assumptions reflect historical trends. This approach provides planners and researchers with a more relevant tool, since Alberta's population growth can show considerable volatility due to economic cycles.

A glossary of demographic terms can be found in Appendix 2.

Methodology and Assumptions

Component Cohort Survival Method

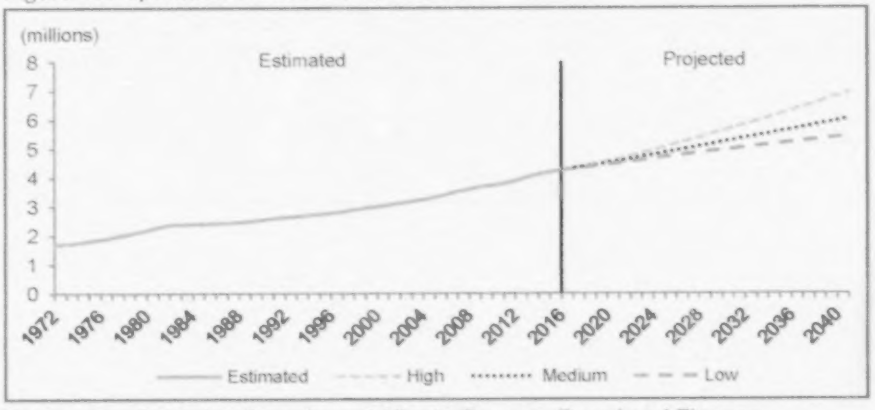
OSI uses the component method to project the future size and age/sex characteristics of the population. This method is essentially a demographic accounting system. It starts with the base-year population distributed by single year of age and sex. Everyone is aged year-by-year, then fertility, mortality and migration assumptions are applied to the base population to project the number of births, deaths, and migrants occurring within the year. Fertility and mortality rates are applied to the population after half the projected number of migrants for the year have been included in the population. This gives some (but not all, or none) migrants a risk of dying or having a birth. Finally, the three components (births, deaths and migration) are either added to or subtracted from the base population to obtain the projected population for the subsequent years. The total population is broken down by sex and single year of age up to the age group of 90 years and over.

The population of Alberta is projected separately from its sub-provincial regions. The component methodology is applied to each of the 19 census divisions (CDs) in Alberta to ensure consistency and comparability. The sum of the CD projections by age and sex cannot exceed the Alberta total; in this way the Alberta level projections function as a control total for the smaller areas. Consistency of the population and components of growth by CD with the Alberta total by age and sex is ensured through a process of two-way raking.

About the Projections

The impact of the 2016 wildfires in Fort McMurray have not been fully captured in these projections. The 2016 population estimate for the region has not been adjusted to include fire impacts, in particular those who have left the region permanently. However, the migration forecast includes assumptions related to economic activity generated by the rebuild in that community.

Figure 1: Population of Alberta, 1972-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

The Base Population

The base population of the projection model is Statistics Canada's postcensal estimates of the population in Alberta and its 19 CDs as of July 1, 2016 (Figure 2). These estimates are based on the 2011 Census, adjusted for net undercoverage and incompletely enumerated Indian Reserves.

Note that Statistics Canada's population estimates only include the resident population, as defined by the census. Residents must usually be living in a specific area to be considered a resident of that area. 'Usual residents' includes non-permanent residents (NPRs)[1], but does not include "mobile" or "shadow" populations, since these people retain a usual residence elsewhere (either outside of Alberta or in a different census division).

Statistics Canada revises the components of population annually to provide the best possible estimates. Revisions use recent updates to data sources or additional data sources only available on an annual basis. These revisions impact some CDs more than others and, coupled with changes to the projection assumptions, can result in higher or lower projected populations in 2041.

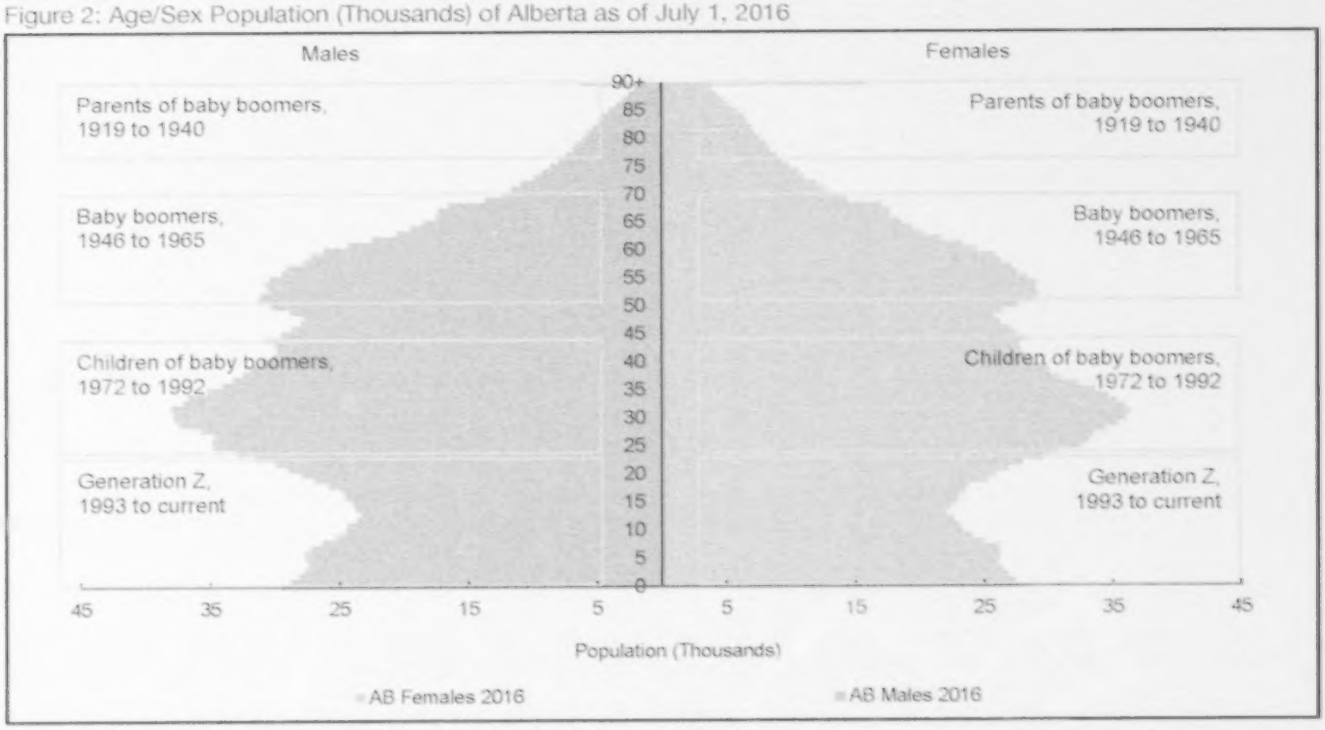
Revised estimates provide a new starting point for the population by age and sex and can have a significant impact on the projected growth and age structure. Since assumptions for several components of growth are based on historical trends, revisions can alter the trajectory of future growth by introducing change to historical patterns. Estimates for the total population in each CD can be found in Appendix 1.

Component Assumptions

In general, the assumptions for fertility (births) and mortality (deaths) are based on detailed analyses of historical trends. Migration assumptions are based on historical trends and assumptions regarding economic drivers of migration such as job creation and industry development. This section presents a more detailed discussion of the historical trends and assumptions for each of the components of growth (see Figure 3).

[1] NPRs are those temporarily residing in Canada with a study, work or minister's permit, or as a refugee claimant, and family members living with them.

Figure 2: Age/Sex Population (Thousands) of Alberta as of July 1, 2016

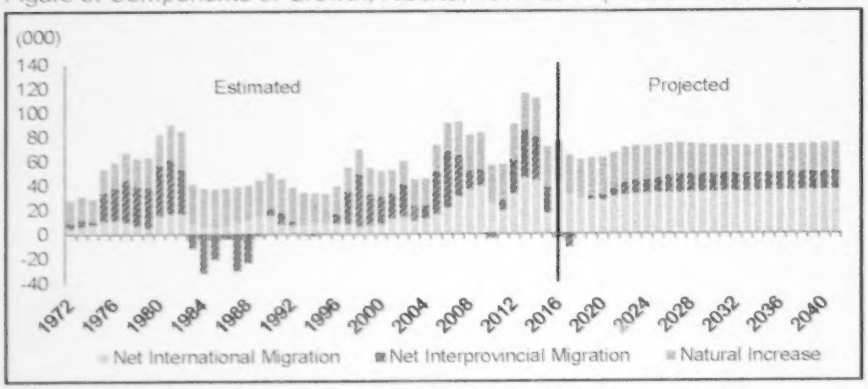


Sources: Statistics Canada and Alberta Treasury Board and Finance
Note: Information boxes indicate generations in 2016.

Fertility Assumptions

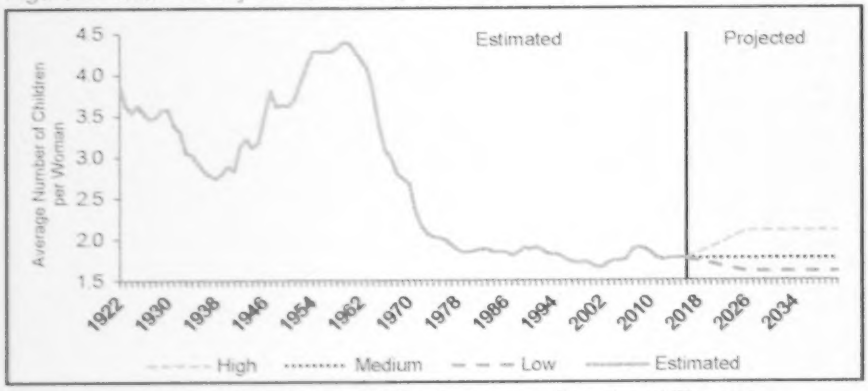
The projected number of births for a given year is generated by applying age-specific fertility rates to the population of women in reproductive ages (15 to 49).

Figure 3: Components of Growth, Alberta, 1972-2041 (medium scenario)



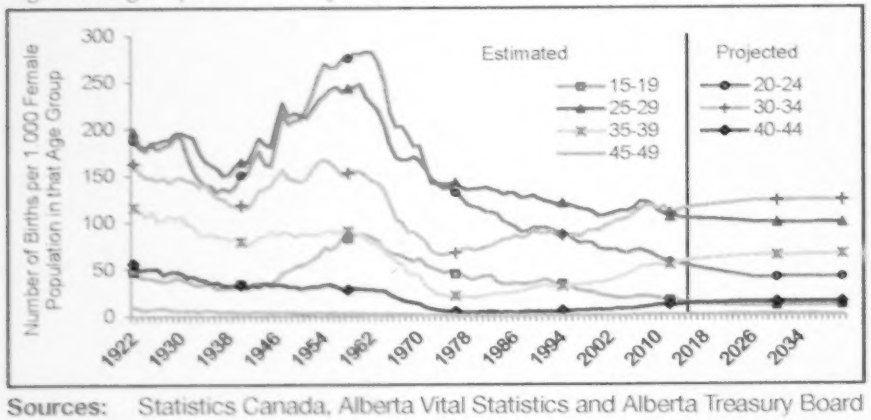
Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 4: Total Fertility Rate, Alberta, 1922-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 5: Age-Specific Fertility Rates, Alberta, 1922-2041 (medium scenario)



Sources: Statistics Canada, Alberta Vital Statistics and Alberta Treasury Board and Finance

Alberta

Alberta's total fertility rate (TFR) dropped below the population replacement level of 2.1 children per woman of childbearing age by the mid 1970s (Figure 4). Fertility has ranged from a baby boom high of 4.39 children in 1959 and 1960 to a low of 1.65 in 2002, but since the late 1970s, it has remained relatively stable, when viewed in the larger historical context. Alberta's TFR was 1.76 in 2016.

Under the medium scenario, the TFR is assumed to stabilize at 1.76. In the low scenario, the total fertility rate is projected to drop and stabilize at about 1.6, which is the equal to the long-term average total fertility rate (1991-2013) for Canada. Under the high scenario, the total fertility rate is assumed to rise gradually and stabilize at around population replacement level of 2.1.

Analysis of age-specific trends in fertility show a long-term shift in the ages that women in Alberta are having children (Figure 5). More women are delaying childbearing and having their first child in their late 20s or early 30s, resulting in a drop in the fertility rates of young women and an increase in the fertility of older women. This trend is projected to continue over the next decade, and then stabilize for the remainder of the projection period.

Regional

There is considerable variation in the fertility rates among census divisions within the province. The TFR in 2016 ranged from highs of 3.24 in CD 17 (Slave Lake) and 3.15 in CD 3 (Pincher Creek) to 1.37 in CD 15 (Banff). Fertility was above replacement in all but six census divisions in 2016. Lower fertility areas included the three census divisions in the Edmonton-Calgary Corridor (CDs 6, 8, 11), CD 15 (Banff), CD 1 (Medicine Hat) and CD 2 (Lethbridge) (Table 1).

Variability in regional fertility is likely related to multiple factors, including variations in average income levels, female educational attainment and employment opportunities, and the proportion of Indigenous peoples in the overall population. For instance, since major urban centers such as Calgary and Edmonton tend to have more educational and career opportunities than other areas of Alberta, women living in and moving to these areas tend to reproduce later in life and have fewer children when compared with women in less urban areas of the province.

Indigenous peoples tend to have higher fertility rates and larger family sizes, resulting in higher fertility rates in areas where they account for a greater proportion of the overall population, such as CD 3 (Pincher Creek), CD 12 (Cold Lake), CD 17 (Slave Lake) and CD 18 (Grande Cache).

In addition to the variation in overall fertility, there are also marked differences in the age patterns of fertility. The estimated median age of women who had a birth in 2016 ranged from a low of 26.5 years in CD 17 (Slave Lake) to a high of 32.3 in CD 15 (Banff) (Table 1). Assumptions were developed for each region according to their own specific character, based on historical data, in order to maintain these regional differences.

Mortality Assumptions

The projected number of deaths are a result of the application of age- and sex-specific mortality rates to the population in each year.

Table 1: Alberta and Census Divisions, TFR and Median Age of Births, 2016

Census Division	Major City/Town	TFR	Median Age of Births
CD1	Medicine Hat	1.99	28.9
CD2	Lethbridge	2.00	29.3
CD3	Pincher Creek	3.15	27.8
CD4	Hanna	2.69	28.6
CD5	Drumheller	2.28	29.2
CD6	Calgary	1.57	31.9
CD7	Stettler	2.54	28.5
CD8	Red Deer	1.95	29.7
CD9	Rocky Mountain House	2.52	28.3
CD10	Camrose	2.11	29.1
CD11	Edmonton	1.61	30.8
CD12	Cold Lake	2.48	28.3
CD13	Whitecourt	2.65	28.3
CD14	Edson	2.17	29.0
CD15	Banff	1.37	32.3
CD16	Wood Buffalo	2.25	30.0
CD17	Slave Lake	3.24	26.5
CD18	Grande Cache	2.51	28.3
CD19	Grande Prairie	2.18	29.1
Alberta		1.76	30.7

Sources: Statistics Canada, Alberta Vital Statistics and Alberta Treasury Board and Finance

Alberta

In 2016 life expectancy at birth for males was 78.9 years, up from 70.7 in 1976. Female life expectancy in 2016 was 83.4 years, compared to 77.7 in 1976. Many of the large historical gains in life expectancy resulted from improvements in infant and child mortality. With the low mortality currently observed at these ages, future gains in life expectancy will likely be more concentrated at older ages (Figures 6 and 7). Projected age-specific mortality rates were derived using a method based on the Lee-Carter model (1992).[2] This model essentially breaks down the age-specific mortality rate (ASMR) into three components: an age-specific constant term, a time-varying mortality index, and an age-specific component that measures how fast mortality at each age varies when the mortality index changes. With the projected mortality index, ASMRs can be calculated for future periods.

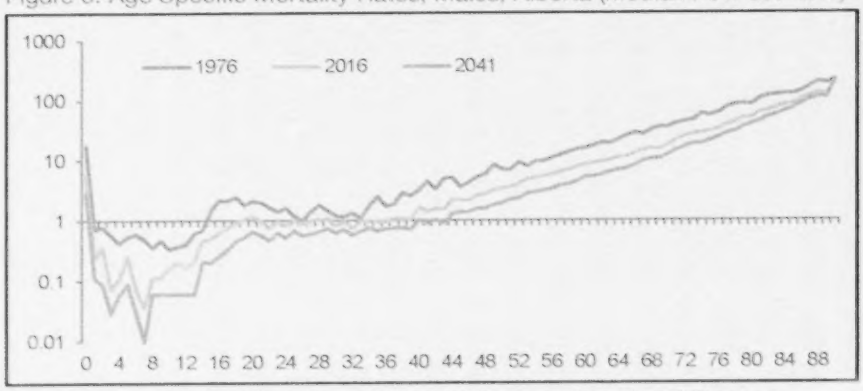
Two sets of mortality assumptions (low/medium and high) were developed. Under both scenarios, life expectancy at birth in Alberta is expected to continue its upward trend in the future. Under the low/medium scenario, life expectancy at birth for females is expected to gain 3.0 years from its 2016 level to 86.5 by 2041, while it would increase by 3.9 years to 82.8 for males. The high scenario introduces a higher growth profile, wherein life expectancy at birth for females would reach 88.9 years in 2041 for a gain of 5.5 years. Compared to 2016, males would add 7.3 more years to their life expectancy for a total of 86.2 years by the end of the projection period under the high scenario (Figure 8).

Under both scenarios, male life expectancy at birth is assumed to

[2] Lee, Ronald D. and Lawrence Carter. 1992. "Modeling and forecasting the time series of U.S. mortality." Journal of the American Statistical Association 87 (419) (September): 659-671.

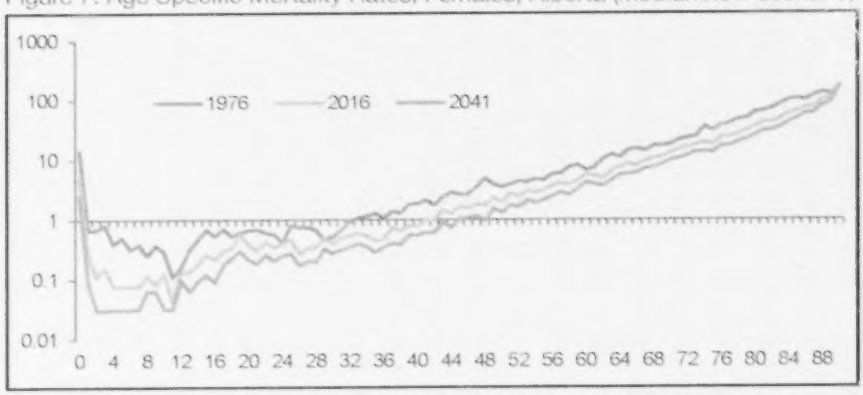
grow at a faster pace than female life expectancy. This is consistent with recent historical trends where males have experienced larger gains than females. Therefore, the sex differential will continue to shrink over the projection period, falling from about 4.5 years in 2016 to 3.7 and 2.7 years in 2041, under the medium/low and high projections, respectively (Figure 8).

Figure 6: Age Specific Mortality Rates, Males, Alberta (medium/low scenario)



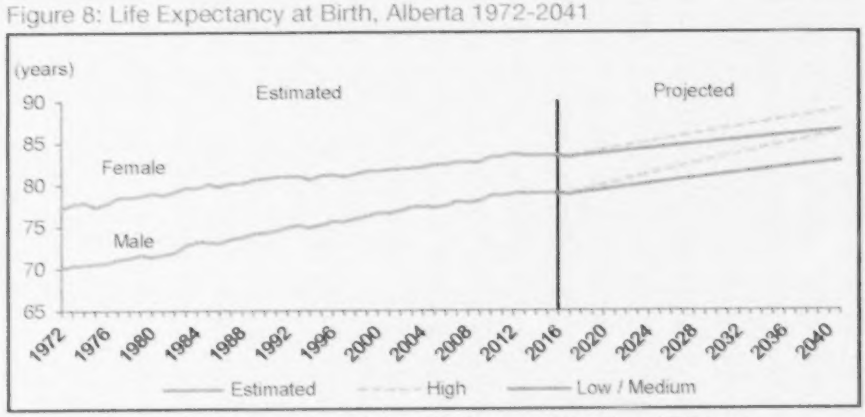
Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 7: Age Specific Mortality Rates, Females, Alberta (medium/low scenario)



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 8: Life Expectancy at Birth, Alberta 1972-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

Regional

Based on historical patterns of mortality change, the Lee-Carter method allows the calculation of projected mortality rates at the Alberta level. The year-to-year change in Alberta's mortality by age and sex is used to calculate a "mortality change factor". This factor is then applied to historical mortality by age and sex for each CD to produce region specific projected ASMRs.

For each CD, ASMRs are calculated from the area's historical data by averaging multiple years of data to the extent required to stabilize the trend. Final projected ASMRs are calculated by multiplying the Alberta-level mortality change rates (from the Lee-Carter model) by these CD-specific ASMRs for females and males.

Migration Assumptions

The projected number of net migrants are a result of separate projections of international (movement from outside the country), interprovincial (movement between provinces and territories) and intraprovincial (movement between CDs) migration. Assumptions about the age and sex distributions of net migrants were developed for each region based on its own characteristics as indicated in historical data.

International Migration

International migration is highly dependent on the Government of Canada's immigration policies and increasingly on the Albertan economy. After hitting a low of 6.0% in 1998, Alberta's share of Canada's immigrants has been increasing, mainly due to the province's strong economy and labour market. In 2016, 17.9% of immigrants moving to Canada settled in Alberta, surpassing

the previous year as the province's highest share of Canada's immigrants on record. The province welcomed over 57,000 immigrants, a new recorded high. Following this strength, immigration to Alberta is expected to soften slightly from recent record levels as a result of economic changes across the country. Despite softening, immigration levels are expected to continue to remain much higher than the historical average, as Canada targets higher immigration levels. Based on historical trends, three immigration scenarios have been developed to capture uncertainty and change within immigration policy. Over the projection period, Alberta is expected to receive over 1.01 million immigrants in the medium scenario, while under the high and low scenarios, Alberta is expected to welcome around 1.29 million, and almost 0.76 million people, respectively.

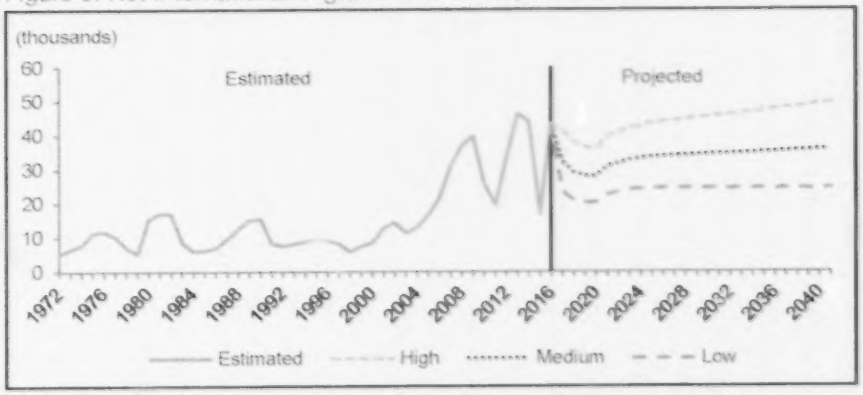
Net emigration (i.e., emigrants minus returned emigrants plus net temporary emigrants) is assumed to increase gradually, as the numbers of in-migrants increase and the province's population expands.

Non-permanent residents (NPRs) are heavily dependent on Federal government policies. Due to Federal changes in the Temporary Foreign Worker (TFW) program, net outflows of NPRs are projected over the next four years. However, outflows are more muted than in previous years' projections. Over the long term, the flow of NPRs is expected to return to a more balanced condition, wherein inflows would be completely offset by outflows.

Due to service industries related to tourism, CD 15 (Banff /Jasper) is an area that historically draws a large number of NPRs. Therefore, this area is expected to be heavily impacted by the net outflows of NPRs. Other areas expected to bear the brunt of the changes include CD 16 (Wood Buffalo), CD 6 (Calgary) and CD 11 (Edmonton).

Overall, net international migration under the medium scenario is expected to be lower than recent years, as strong immigration offsets net outflows of NPRs and moderate emigration rates. In the high scenario, immigration is projected to be strong enough to lift net international migration higher than the historical average, while net international migration in the low scenario will remain well below the levels of the last ten years (Figure 9). Between now and 2041, Alberta is expected to receive close to 836,000 net international migrants under the medium scenario. Under the high and low scenarios about 1.11 million and 0.59 million net international migrants are projected to move to Alberta, respectively.

Figure 9: Net International Migration to Alberta, 1972-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

Interprovincial Migration

Net interprovincial migration is strongly driven by Alberta's labour market conditions and its performance relative to other provinces. This migration component reacts with a lag, which means that despite signs of economic recovery in the province, Alberta is forecasted to see continued net outflows of interprovincial migrants in 2017. As Alberta's economic situation continues to improve, net interprovincial migration is forecasted to slowly return to its long term historical trend (Figure 10).

Low oil prices weighed on energy investment in Alberta, slowed employment growth and wages, and increased unemployment. Net interprovincial migration slowed sharply and turned negative, with net outflows of interprovincial migrants expected again in 2017. However, these net outflows are very small compared to the net gain of over 120,000 new residents between 2011/12 and 2014/15. Based on year-to-date estimates, net interprovincial migration is expected to fall to a low of -11,000 in 2017. Interprovincial migration is expected to gradually recover as economic growth resumes. The long term average for the medium projection is about 15,000 net interprovincial migrants annually. The high and low scenarios project about 23,700 and 7,900 yearly interprovincial migrants, respectively (Figure 10).

The regions expected to bear the brunt of net outflows of interprovincial migrants are CD 6 (Calgary), CD 8 (Red Deer), CD 10 (Camrose), CD 11 (Edmonton) , CD 12 (Cold Lake), CD 16 (Wood Buffalo) and CD 19 (Grande Prairie).

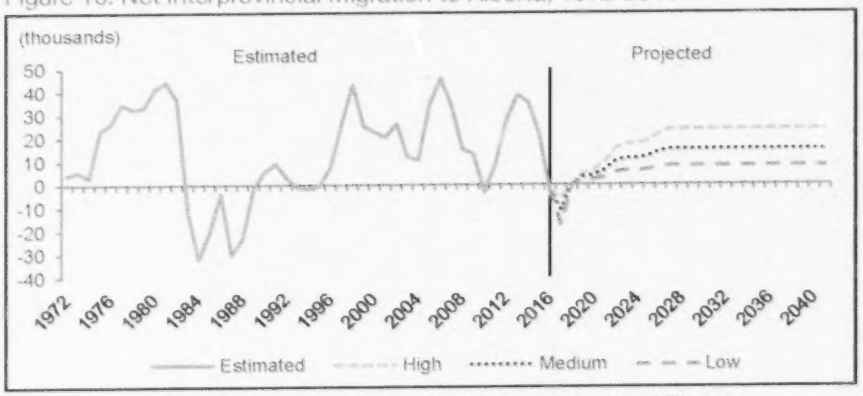
Intraprovincial Migration

The projected number of people moving between CDs is developed using long term averages. Net intraprovincial migration has no impact on Alberta's overall population growth, so only one scenario has been developed for this projection. Historically, CD 6 (Calgary) and CD 11 (Edmonton) have welcomed a large number of intraprovincial migrants, as has CD 8 (Red Deer). CD 5 (Drumheller) has also, on average, gained a positive number of net intraprovincial migrants. All other census divisions tend to lose population to other areas of the province on a net basis. In particular, CD 16 (Wood Buffalo) historically has sent large amounts of people elsewhere in the province, along with CD 17 (Slave Lake). Over the next 25 years, over three-quarters of net intraprovincial migrants within Alberta are expected to move to the two largest urban centers, Calgary and Edmonton, for employment and educational opportunities.

Total Net Migration

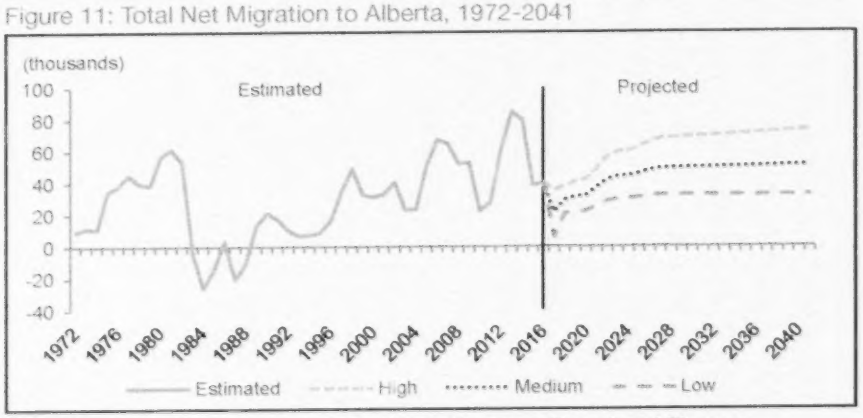
Combining all migration components, total net migration is expected to slow from the strong showing in 2016, dropping to around 21,200 in 2017 under the medium scenario (Figure 11). This level is projected to continue to modestly increase in 2018, as net outflows of interprovincial migrants taper off. Following that, total net migration should increase, returning to its long term historical trend.

Figure 10: Net Interprovincial Migration to Alberta, 1972-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

Figure 11: Total Net Migration to Alberta, 1972-2041



Sources: Statistics Canada and Alberta Treasury Board and Finance

Within the province, regions with more employment and educational opportunities tend to attract more migrants. Of the anticipated 1.12 million net migrants moving to Alberta over the next 25 years, 87% are expected to settle in the two major urban centers (i.e., CD 6 (Calgary) and CD 11 (Edmonton)).

Given the current uncertainty surrounding oil prices, and muted outlook for prices over the long term, investment in new projects has not been announced. With lower investment, areas with substantial oil sands development, such as CD 16 (Wood Buffalo) and CD 12 (Cold Lake) are expected to continue to experience a few years of net out-migration. CD 12, a region that historically loses net migrants, will return to a more moderate level of loss over the long term. CD 16 is forecast to experience lower net losses in 2017 compared to the previous year's projections because of rebuild efforts following the Fort McMurray fire in May 2016. In the long term, CD 16 is expected to return to a more moderate level of positive net migration. Given uncertainties in the oil sands resources and continued fire-related developments, volatility in migration flows is expected for CD 16.

Areas which service the oil and gas sector, such as CD 19 (Grande Prairie) and CD 8 (Red Deer), saw their migration impacted last year. This trend is expected to continue into 2017, but should recover fairly quickly since these areas service other sectors, and because of improvements in gas and conventional drilling. CD 19, a service area for both Alberta and British Columbia, will see higher long-term net inflows of migrants. CD 8's proximity to the province's large urban centers and its location in the Edmonton-Calgary Corridor, as well as drilling increases, are expected to

continue to buffer the region from some of these impacts. Population growth in this region is forecast to stabilize this year before returning to stronger growth over the projection period.

Home to a large number of oil companies' Alberta headquarters, CD 6 (Calgary) was also significantly impacted by the global oil price shock with declines in employment, as companies tried to reduce costs. In 2016, CD 6 saw a net outflow of interprovincial migrants. However, growth in that region was buffered by strong numbers of immigrants. In 2017, net migration to CD 6 is expected to remain positive, but will likely moderate as net outflows of interprovincial migrants continue and immigration softens from last year's high. In 2018, CD 6's net migration is expected to begin its recovery.

Employment in the majority of industries in CD11 (Edmonton) was not hit as hard as CD 6 last year. However, as major construction projects begin wrapping up, net migration to CD 11 is expected to slow. As CD 6 begins to recover, its net migration is expected to pick up. Due in part to the propensity of immigrants to move to CD 6, growth due to migration in this region is forecasted to remain above CD 11 for the entire projection period. Over the long term, these two regions will return to their projected long term net inflows of migrants.

Lethbridge was designated the province's newest census metropolitan area (CMA) in the 2016 Census, as it hit a size and density that puts it in the company of other metropolitan areas in the country. Given its diversified economy, CD 2 (Lethbridge) has weathered the economic storm and remained an attractive destination for migrants to the province. While migration to the rest of the province dips, and then slowly recovers, CD 2 is expected to see migration levels in line with its long term historical average throughout the projection period.

For more information on the *Population Projections* see:

Population Projections, Alberta and Census Divisions, 2017-2041.
Provides some discussion and details of the provincial and regional projected populations.

Data for Alberta Population Projections.
Includes estimated (1996-2016) and projected (2017-2041) population of Alberta and its 19 Census Divisions by single year of age and sex as well as selected summary statistics.

Contact

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Appendices

Appendix 1: Census Divisions and Their Respective Populations as of July 1, 2016

Census Division	Major City/Town	2016
Alberta		4,252,879
CD1	Medicine Hat	85,081
CD2	Lethbridge	175,532
CD3	Pincher Creek	40,393
CD4	Hanna	9,799
CD5	Drumheller	57,260
CD6	Calgary	1,576,249
CD7	Stettler	41,049
CD8	Red Deer	216,610
CD9	Rocky Mountain House	22,217
CD10	Camrose	99,175
CD11	Edmonton	1,432,572
CD12	Cold Lake	73,147
CD13	Whitecourt	69,625
CD14	Edson	29,863
CD15	Banff	40,425
CD16	Wood Buffalo	76,566
CD17	Slave Lake	65,797
CD18	Grande Cache	15,285
CD19	Grande Prairie	126,234

Source: Statistics Canada

Appendix 2: Glossary of Demographic Terms

Age Specific Fertility Rate	Number of births per 1,000 women of a specific age within the childbearing age range, normally age 15 to 49 years.
Baby Boomer Period	Period following World War II (1946–1965), marked by an important increase in fertility rates and in the absolute number of births.
Components of Population Growth	Births, deaths and migration are components that alter the size of the total population and its composition by age and sex.
Emigrant	Canadian citizen or immigrant who left Canada to settle permanently in another country.
Immigrant	Person who has been permitted by immigration authorities to live in Canada permanently.
International Migration	Movement of persons between Canada and other countries.
Interprovincial Migration	Movement from one province/territory to another resulting in a permanent change in residence. A person who takes up residence in another province is an out-migrant with reference to the province of origin and an in-migrant with reference to the province of destination.
Intraprovincial Migration	Movement within the province from one Census Division to another resulting in a permanent change in residence.
Median Age	Age "x", such that exactly one half of the population is older than "x" and the other half is younger than "x".
Migration	Permanent change of residence from one geographical unit to another.
Mortality Rate	The number of deaths per 1,000 individuals in a defined population for a particular time period.
Natural Increase	Population change resulting from only the births and deaths within that population.
Net International Migration	Equal to: immigrants – emigrants + returning emigrants – temporary emigrants + net non-permanent residents
Net Interprovincial Migration	Difference between in-migrants and out-migrants for a given province or territory.
Net Migration	Difference between in-migration and out-migration for a given area and period of time.
Net Non-Permanent Residents	Variation in the number non-permanent residents between two dates.
Net Temporary Emigrants	Variation in the number of temporary emigrants between two dates.
Net Undercoverage	Difference between the number of persons who were covered by the census but who were not enumerated (i.e. undercoverage) and the number of persons who were enumerated when they should not have been or who were enumerated more than once (i.e. overcoverage).
Non-Permanent Residents	Persons from another country who had an employment authorization, a student authorization, or a Minister's permit, or who were refugees claimant, and family members living with them.
Population Growth	Total change in the population of a given geographic unit in a given period, resulting from fertility (births), mortality (deaths) and migration.
Population Projection	An estimate of a future population derived from calculations made on certain assumptions of fertility (births), mortality (deaths) and migration.
Population Pyramid	A chart which shows the distribution of a population by age and sex.
Replacement Level (Fertility)	Mean number of births per woman necessary to assure the long-term replacement of a population for a given mortality level. Currently, the replacement level in Canada and most other developed countries is about 2.1 children per woman.
Returning Emigrants	Canadian citizens or landed immigrants who have emigrated from the country and subsequently returned to Canada to re-establish a permanent residence.
Shadow Population	Individuals who reside in one region on a temporary basis, while their primary residence is located somewhere else. They are enumerated by the census as residents of the jurisdictions where their primary residence is located.
Temporary Emigrant	Canadian citizen or immigrant who left Canada to settle temporarily in a foreign country.
Total Fertility Rate	The sum of age-specific fertility rates during a given year. The TFR indicates the average number of children that a generation of women would have if, over the course of their reproductive life, they had fertility rates identical to those of the year considered.
Two-Way Raking	An adjustment method (also known as the "Deming method") where proportions are distributed to ensure that the age and sex of the census divisions equal the province's total population.

Sources: Statistics Canada and Alberta Treasury Board and Finance